AP Biology, Semester 2
Unit Quiz: The Energetics of Life
Instructor Version

Section I: Multiple-Choice Questions

Answer Sheet

1.	D
2.	C
3.	A
4.	D
5.	B
6.	A
7.	E
8.	A
9.	C
10.	E

11.	D
12.	C
13.	B
14.	B
15.	D
16.	E
17.	D
18.	A
19.	B
20.	E

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Section II: Free-Response Questions

Time Limit: You have 30 minutes to complete this section. Both questions are weighted equally, so allow around 15 minutes for each question. You may move back and forth between questions until time is called.

Scoring: 20 points each, 40 points total

Directions: Answer each of the questions in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement your answer, but a diagram alone is insufficient. Read each question carefully before you begin to write your answer.

1. **Cells use proteins and amino acids for energy as well as carbohydrates such as glucose. Apply what you know about glucose metabolism to discuss each of the following topics.**

   A. The free energy change for the committed step in the catabolism of an amino acid

   The committed step is an irreversible step with a large, negative free energy change. This is true for essentially all metabolic pathways.

   B. The regulation of metabolic pathways that degrade amino acids

   Diverse metabolic pathways are regulated in similar ways. We can apply what we know about the regulation of glycolysis and the TCA cycle to the metabolic pathways that degrade amino acids, especially since amino acid degradation products feed into the TCA cycle.

   For example, feedback inhibition is common. The enzymes that catalyze the committed step are likely to be regulated through allosteric interactions and covalent modifications. Such pathways also may be regulated by substrate availability or by hormones and other regulators.

   C. The role of molecular oxygen in the breakdown of amino acids for energy

   Like glucose, the breakdown of amino acids involves carbon oxidation. Under aerobic conditions, the degradation products of amino acids feed into the TCA cycle. The TCA cycle generates reduced coenzymes, which feed electrons into the electron transport chain. The final electron acceptor in the electron transport chain is molecular oxygen, which is reduced to water.

2. **How does enzyme specificity depend on structure and how are enzymes regulated?**

   An enzyme's tertiary structure allows it to form many contact points, or binding interactions, with its substrate. These interactions depend on the enzyme's structure as well as the structure of the substrate. A molecule with a slightly different shape doesn't fit as well as the substrate into an enzyme's active site so it doesn't form as many binding interactions with the enzyme. Enzymes only efficiently catalyze reactions when there are many enzyme-substrate binding interactions. The need to form many contact points for catalysis is the basis of enzyme specificity. An enzyme's shape allows it to specifically bind and react with the proper substrate.

   The binding of activators and inhibitors allosterically regulates some enzymes. The effectors change the enzymes shape, or structure, and alter its substrate interactions.

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Covalent modifications such as phosphorylation also regulate enzymes. Such covalent modifications alter the enzyme's structure and its substrate interactions.

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